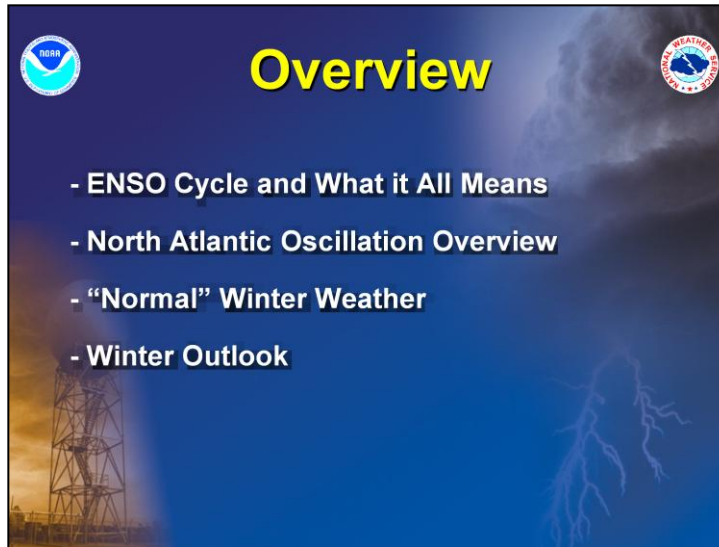

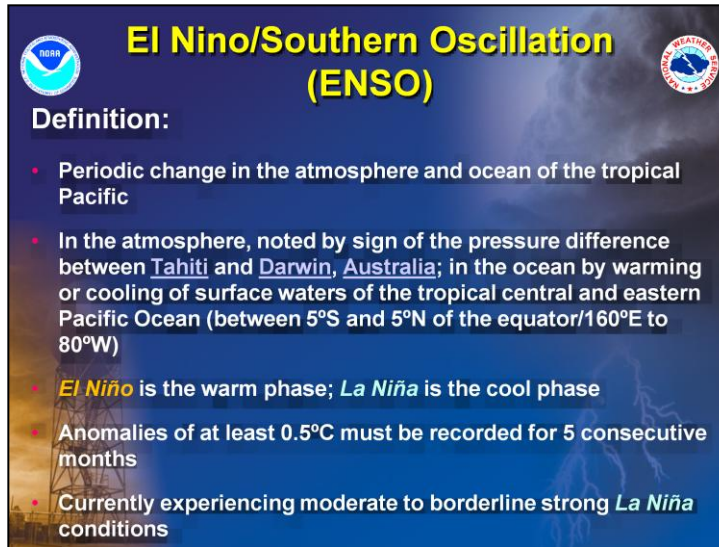



Welcome to the winter weather outlook for winter 2010/2011.



During this presentation, we will look at a few things that drive long term weather patterns on the order of a few weeks to several months. These include the ENSO (El Nino Southern Oscillation) and the NAO (North Atlantic Oscillation). We will also look at what a “normal” winter entails around these parts, concluding with the winter weather outlook from your NWS office in Gaylord.



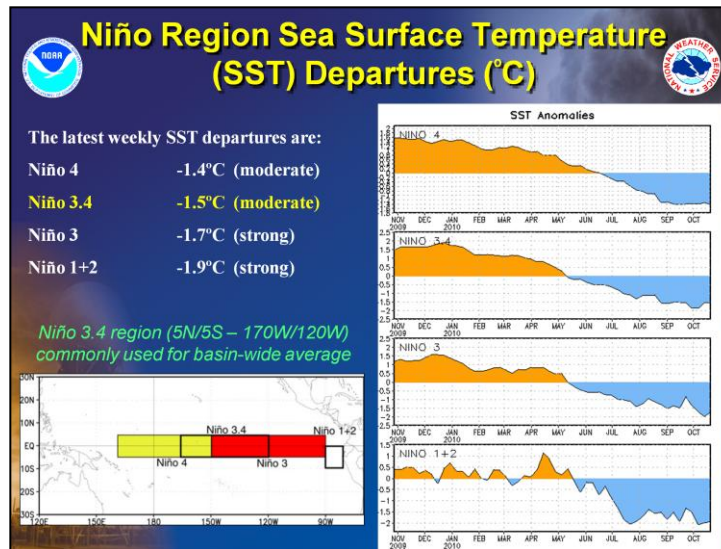
El Nino/Southern Oscillation (ENSO)



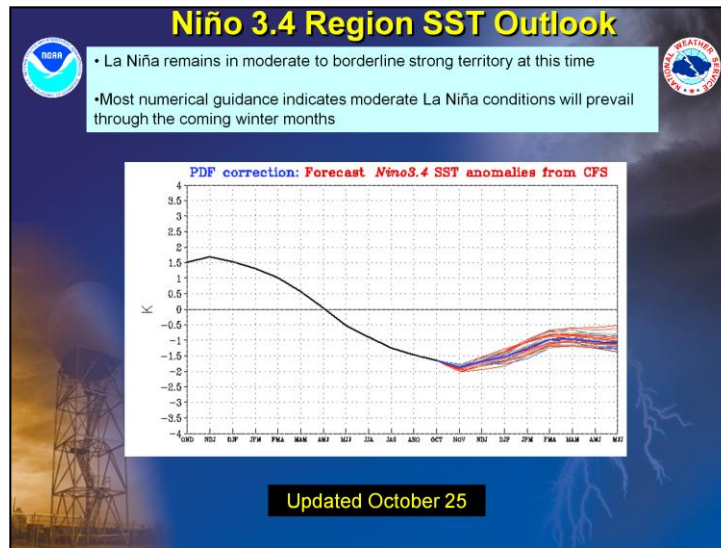
Definition:

- Periodic change in the atmosphere and ocean of the tropical Pacific
- In the atmosphere, noted by sign of the pressure difference between Tahiti and Darwin, Australia; in the ocean by warming or cooling of surface waters of the tropical central and eastern Pacific Ocean (between 5°S and 5°N of the equator/160°E to 80°W)
- **El Niño** is the warm phase; **La Niña** is the cool phase
- Anomalies of at least 0.5°C must be recorded for 5 consecutive months
- Currently experiencing moderate to borderline strong **La Niña** conditions

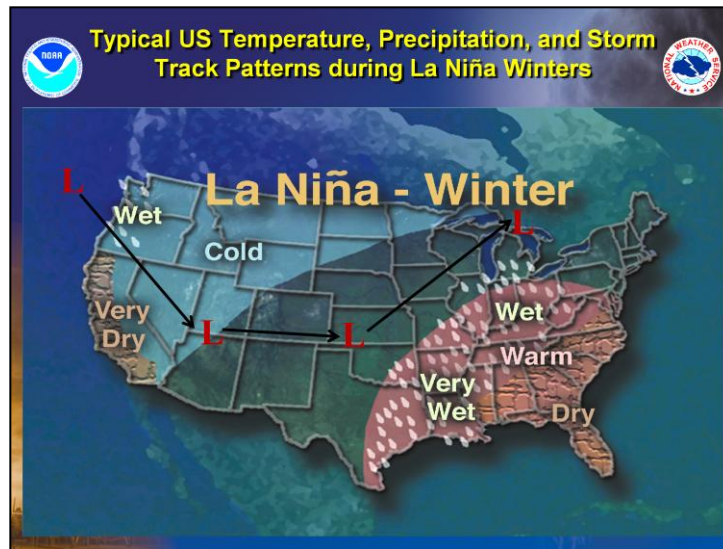
This slide defines what the El Nino/Southern Oscillation is, and how it is recorded. Generally speaking, for an El Nino or La Nina to be considered, the tropical Pacific waters must exhibit anomalies of +/-0.5°C or greater.



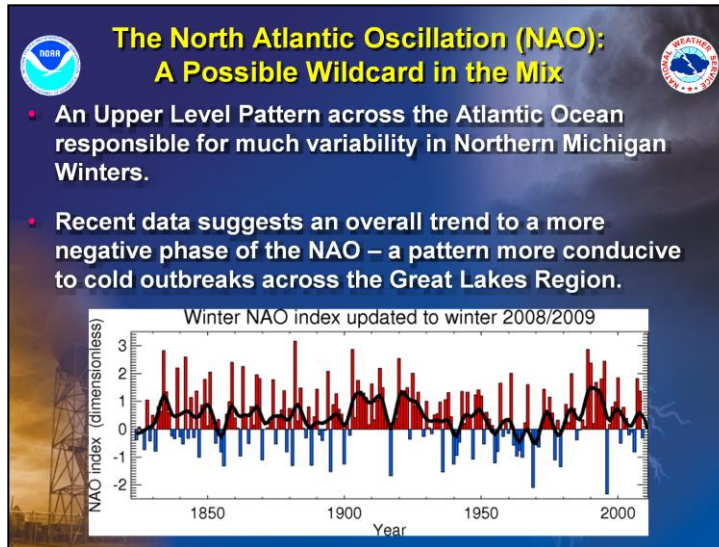
We are currently experiencing moderate to borderline strong La Niña conditions, after a very strong El Niño occurred last year. Notice the rapid change in temperatures throughout the tropical Pacific ocean.



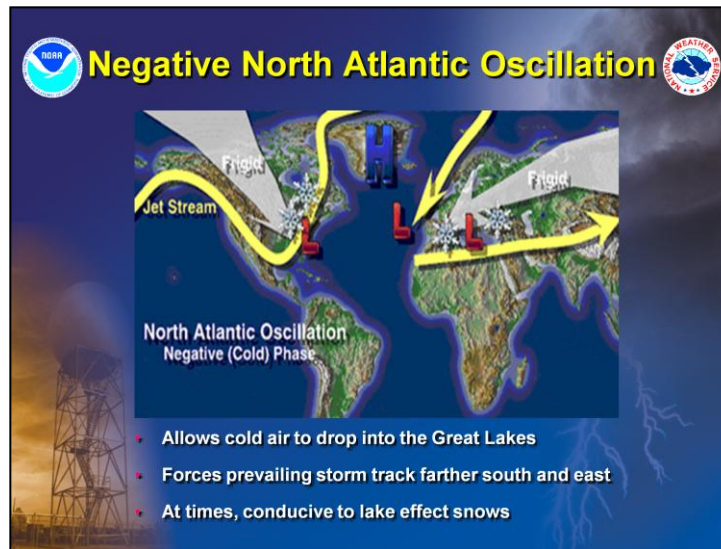
CFS Model forecast of Nino 3.4 region. Great consistency with all members showing La nina conditions persisting through much of the winter.



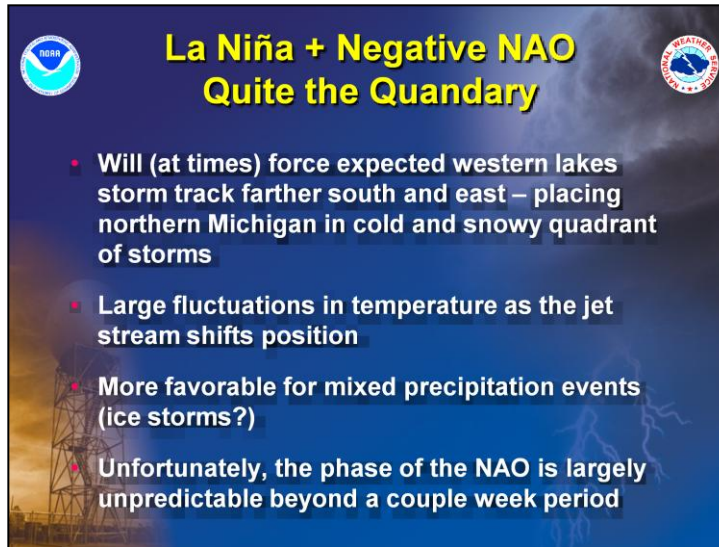
Map showing the basic La Nina pattern to expected through the wintertime months.



NAO slide...notice the recent trend toward negative territory. Strong evidence to suggest this is a roughly 30-year cycle, with a trend toward negative territory possible over the next 3 decades (after some very warm records back in the 1980s/1990s).



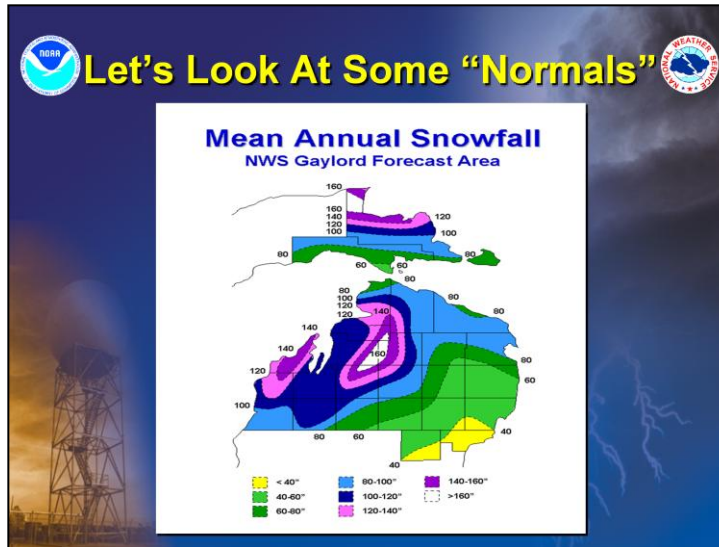
Slide showing the rough pattern when the NAO is negative.



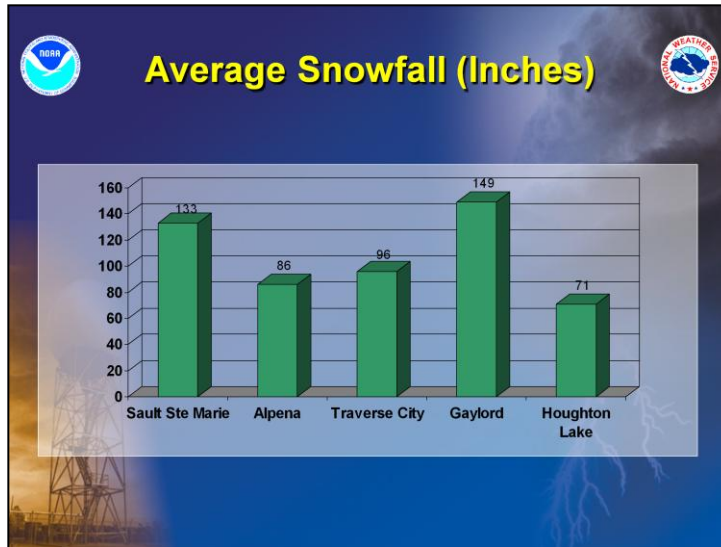
La Niña + Negative NAO
Quite the Quandary

- Will (at times) force expected western lakes storm track farther south and east – placing northern Michigan in cold and snowy quadrant of storms
- Large fluctuations in temperature as the jet stream shifts position
- More favorable for mixed precipitation events (ice storms?)
- Unfortunately, the phase of the NAO is largely unpredictable beyond a couple week period

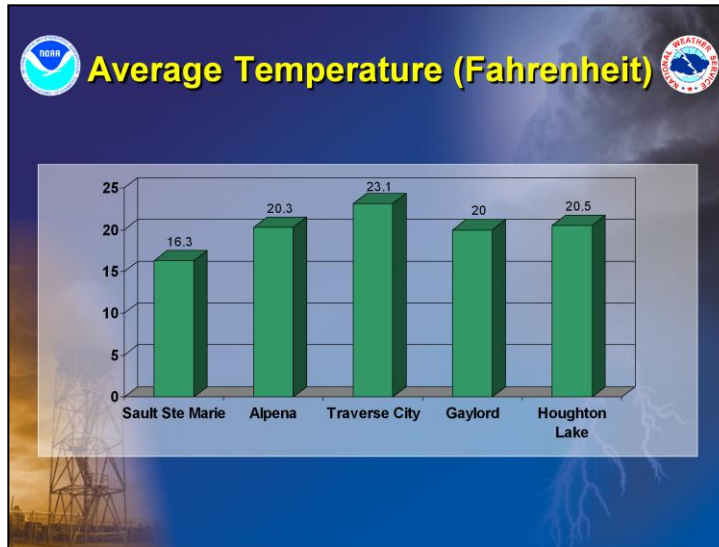
Slide showing possible outcomes of a La Nina and negative NAO pattern.



A quick look at average annual snowfall throughout northern Michigan



Site-specific average annual snowfall.



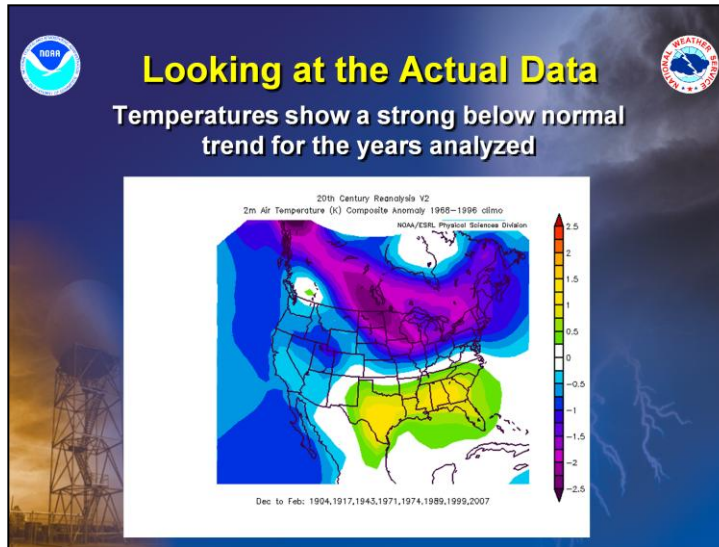
Average temperatures during the December through February timeframe for a few sites around northern Michigan.



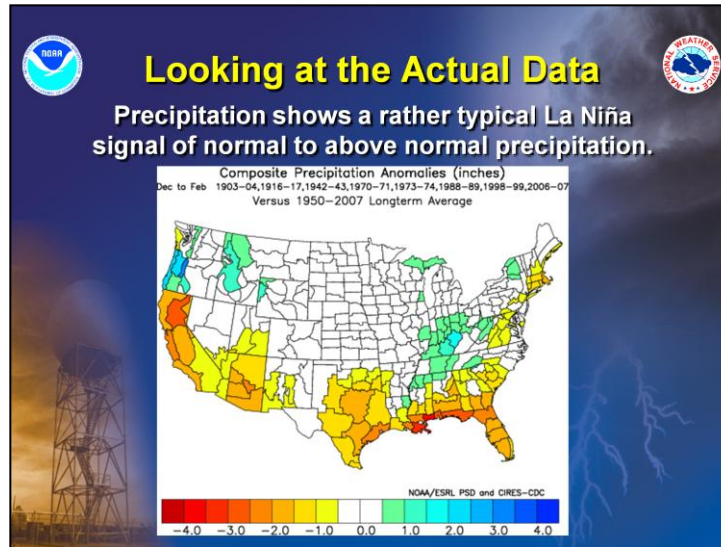
Using Past Years to Forecast the Future

- **Analog forecasting – using similar previous seasons or ENSO setups to forecast the coming season**
 - *In this case, we use years in which a moderate/strong El Niño transitioned to a moderate/strong La Niña.*
 - *Only a handful of years when this has happened...relatively rare. (1903-04, 1916-17, 1942-43, 1970-71, 1973-74, 1988-89, 1998-99, 2006-07)*
- **Using this data, a rather consistent picture emerges for December - February:**
 - *Below normal temperatures*
 - *Normal to above normal precipitation*

This slide describes a process known as analog forecasting. Simply put, we can use past similar years (and what happened then) to aid us in forecasting a possible outcome for winter. In this case, we focused on those years with an El Niño during the spring/summer months that rapidly transitioned to a La Niña scenario, just like what has occurred over the past 9 months. There are only a handful of years where this has occurred, with those years being used heavily to help us forecast the coming winter.



A composite map showing the temperature anomalies from the years listed on the previous slide (the analog years). Notice the sharp intrusion of quite cold temperatures (below normal) across the northern tier of states down into the Great Lakes and Northeast United States.



Precipitation pattern associated with the years listed previously. Unfortunately, precipitation records are not nearly as accurate or readily available as temperature data before 1950, so that doesn't help us much. However, you can still see a general trend for above normal precipitation through the Ohio Valley, with some hints of above normal readings into the Great Lakes as well (the green shadings).

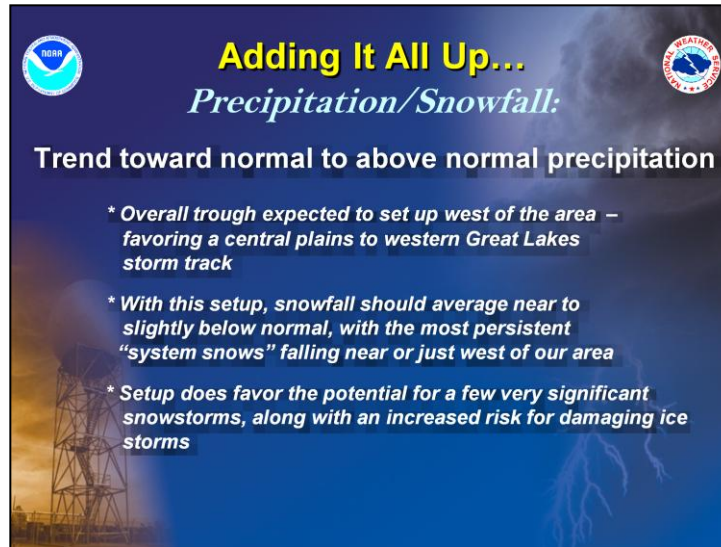
Adding It All Up...
Temperatures:



Good chance for normal to below normal temperatures for December through March (meteorological winter).

- * *Well established moderate La Niña*
- * *Negative phase of the NAO favored*

Potential for a few periods of extreme variability (rapid temperature swings) as the NAO changes phases

Summary slide for temperatures. We expect temperatures to average below normal through meteorological winter (December through February). However, the potential exists for some periods of rapid transition as the NAO pattern relaxes briefly, perhaps allowing for some significant warmups to occur.



 **Adding It All Up...** 

Precipitation/Snowfall:

Trend toward normal to above normal precipitation

- * Overall trough expected to set up west of the area – favoring a central plains to western Great Lakes storm track*
- * With this setup, snowfall should average near to slightly below normal, with the most persistent “system snows” falling near or just west of our area*
- * Setup does favor the potential for a few very significant snowstorms, along with an increased risk for damaging ice storms*

Precipitation is also expected to be normal to above normal through the winter, though this doesn't necessarily mean above normal snowfall, as some systems may well cut to our west, putting northern Michigan on the warm side of things (with rain falling).



All in all, we expect a colder than normal and wetter than normal winter throughout northern Michigan.